MONANA

JOURNAL of the AUSTRALIAN METEOROLOGICAL ASSOCIATION

Vol. 1 No. 4, October, 1971

CONTENTS

	Page
TROPICAL DISTURBANCE ELINE - 1898 - E. Brewster Buxton	1
STANDARD TIMES IN AUSTRALIA	3
THE R.A.A.F. JUBILEE DISPLAY AT EDINBURGH, S.A. 17th APRIL, 1971 - N.T. Lied	6
HURRICANE NAMES - NEWS RELEASE FROM U.S. DEPARTMENT OF COMMERCE MAY, 1971	9
ANTARCTICA AND ANTARCTIC METEOROLOGY - N.T. LIED	13
APPRECIATIVE REFERENCES - BUREAU OF METEOROLOGY - FEBRUARY, 1971	17
USING THE WEATHER FORECASTS TO BEST ADVANTAGE IN FIRE FIGHTING - THE WILLASTON (S.A.) FIRE - 17th JANUARY, 1969 - E.H.V. Riggs	19
THE BUSH FIRE - Laurie Wells	22
SOME METEOROLOGICAL ASPECTS OF AIR POLLUTION - J. Hogan	23
THE USE OF GHOST BALLOONS TO OBTAIN UPPER ATMOSPHERE DATA AND A SUMMARY OF RECENT LAUNCHINGS AT DARWIN	29

TROPICAL DISTURBANCE ELINE - I898

by E. Brewster Buxton, Montreal, Canada

from "WEATHERWISE"

Tropical storms bearing the names of soft-eyed Polynesian damsels often swept through the South Pacific in the I890's and early I900's setting an early precedent for the current practice of giving feminine names to hurricanes.

Clement L. Wragge, a pioneer meteorologist in Australia, was responsible for this convenient and practical method of identifying and tracking these storms from day to day and week to week. His custom of christening tropical storms with the names of island beauties he admired was actually part of a broader system for classifying several weather types, the most common being the cold, blustery cyclones on the polar front. For these troublesome storms, which so regularly harassed the farmers and sailors in his part of the world he reserved the masculine names of potiticians unsympathetic toward subsidies for his various projects. With this system he was able to focus public attention on his critics and to associate devastating gales and floods with government neglect of his weather services. Recognizing the origin of monsoon air masses which affect Australia on a seasonal basis, he labelled these incursions from the northern hemisphere with proper names suggestive of Asia and the Middle East, and sometimes for a supporter of one of his projects.

An immigrant to Australia in about I876, Clement Wragge was a man with a colorful personality and a flair for publicity. With experience gained as a Gold Medallist of Ben Nevis Observatory in Scotland, he established observatories on Mt. Lofty in South Australia, Mt. Wellington in Tasmania and Mt. Kosciusko in New South Wales. He was one of the early "rain makers" using Stiger vortex cannons in noisy attempts to induce precipitation from stubborn cumulus clouds. Characteristically, he gave these spectacular installations names like "Stiger", "Leahey" and "Wragge" - probably to stimulate public interest and to acknowledge stockholder support.

In I887 Wragge organized the Queensland Weather Bureau in Brisbane and boldly dispensed his forecasts far beyond the borders of his own State. Written in a narrative style, his forecasts were directed at farmers and sailors and made effective reference to his personified storms. Thus, a six-day outlook went something like ....."Under the influence of Antarctic disturbance Sir Joseph Ward, rough seas will prevail over the southern oceans and sailing ships will probably be under close-reefed topsails"..... "Tropical storm Leonata is still hanging around the Queensland coast."..... "A new monsoon which we will call Lewis after a supporter from Tasmania will long be remembered for its beneficial rains."

Among his many activities, Wragge travelled extensively through Queensland delivering lantern slide lectures on "The Cosmos". Announced ahead of time, with notices in stores and with the help of bell ringers, the lectures followed a routine which commenced with an introduction by a member of the clergy and concluded with the traditional God Save the King slide. The lectures themselves encompassed the whole gamut of heavenly events. Although he stuttered a bit, his intonations and sophisticated

expressions impressed his intellectual audiences while his repertoire of sea stories and chanties ensured his popularity with less dignified groups. He has been described as a tall, ungainly man with scraggly whiskers, and when loaded down with his scientific equipment, which was calculated to impress his audiences, he must have looked more like an adventurous South Sea Trader than a dedicated natural scientist.

His journal "Wragge", published while he was the government astronomer and meteorologist of Queensland, provided a medium for publicising his maps and forecasts and for promoting a variety of other weather projects. In this weekly gazette of some half-dozen pages dedicated to "God, King, Empire and People", Wragge managed to show how the weather of the preceding week had followed his prognostications or to give rational explanations for events not forecast. These dissertations were interspersed with a sort of continued story called Meteorographica in which meteorological theory was expounded. When assailed in the House of Representatives as a "Hottentot Rain God", or hounded by creditors and critics, his columns would denounce these short-sighted enemies of science in scholarly vernacular. Advertisements for his specialized private forecasts and lectures were also strategically spotted in this official publication. Reviewing his own lectures in the journal, he was not conspicuously modest and employed such phrases as: "The lecturer meditatively remarked ... etc ... (Applause) ... etc."

He was the author of the book, "Romance of the South Seas", published in 1903, which presents an interesting picture of life in the islands during the days of sailing ships. In his writings he displayed great admiration for the "Dusky maidens with liquid eyes and bewitching manners".

In later years after his career as head of the Queensland Meteorological Service had ended, Wragge produced long range forecasts based on sun spot cycles which were apparently fairly successful during the period 1913-17. When these correlations failed to hold up in later years, he introduced a 19-year cycle based on lunar declination with results which have not been verified.

Clement Wragge spent his last years in New Zealand, near Auckland, where he continued his weather studies and cultivated a tropical garden. He died in 1922 with many old timers still maintaining that unusual droughts and storms in Australasia were predicted by "Inclement" Wragge, F.R.G.S., F.R. Met. Soc., F.R.C.I. etc.

STANDARD TIMES IN AUSTRALIA

Prior to I895 the official time in the several colonies was for most purposes the mean solar time of the capital city of each.

In November, I892, an intercolonial conference of surveyors was held in Melbourne to consider, among other things, the advantages of introducing the system of standard time. In this system it was proposed to make the initial meridian that of Greenwich, and to change local standard time by whole hours according to the longitude east or west of that of Greenwich. Thus for every difference of I5 degrees in longitude a change of one hour would be required. The minutes and seconds would then be identical everywhere.

To give effect to this proposal it was suggested that Australia should be divided into three zones the standard times for which should be respectively the mean solar times of the meridians of I20 degrees, I35 degrees and I50 degrees East longitude thus giving standard times 8, 9 and I0 hours respectively ahead of Greenwich time. It was proposed that the I20 degree zone should comprise Western Australia, that the I35 degree zone should comprise South Australia and the Northern Territory, and that the I50 degree zone should comprise Queensland, New South Wales, Victoria and Tasmania.

The matter was also considered by several intercolonial postal conferences, and eventually in I894 and I895 legislation was enacted by each of the colonies in accord with the recommendations of the Surveyors' Conference of I892.

In I898 the South Australian legislature amended its earlier provision, and adopted the mean solar time of the meridian I42 degrees 30 minutes East longitude as the standard time for that colony, thus reducing the difference between the standard time of Adelaide and that of the capitals of the eastern colonies from an hour to half an hour. Particulars concerning these enactments are as follows:-

STATE	DATE WHEN ACT CAME INTO OPERATION	MERIDIAN SELECTED	TIME AHEAD OF GREENWICH HOURS
New South Wales	Ist February, I895	I50° E	I0
Victoria	Ist February, I895	I50° E	I0
Queensland	Ist February, I895	I50° E	I0
South Australia	Ist February, I895	I35° E	9
South Australia	Ist May, I899	I42° 30'	9½
Western Australia	Ist December, I895	I20° E	8
Tasmania	Ist September, I895	I50° E	I0

The standard time in the Australian Capital Territory is the same as in New South Wales, and the Northern Territory the same as in South Australia.

Consequent upon the opening of the Trans-Australian Railways an arrangement was made by which the change of time between South Australia and Western Australia (namely I½ hours) was divided into two changes of 45 minutes each. Going east from Kalgoorlie the first change was made at Rawlinna, 235.I8 miles out, where the time was put forward by 45 minutes. The second change of the same amount was made at Tarcoola

794.05 miles out. Thenceforward South Australian Standard Time was kept. The Commonwealth Observatory at Mt. Stromlo, Canberra and the State Observatories at Sydney, Adelaide and Perth derived time by astronomical observation. A Commonwealth Time Service was then developed.

THE LAST TIME SOUTH AUSTRALIA TURNED BACK THE CLOCK

Just before 2.00 a.m. on January Ist, I942, a maintenance mechanic climbed up the stairs and ladders inside the Adelaide G.P.O. clock tower. He fiddled among the cogs and wheels, slowly cranking the four sets of hands forward one hour.

When the clock should have struck two, it struck three. Adelaide had swallowed an hour in the interests of daylight saving.

It wasn't the first time. Australia had tried advancing the clocks in summer of I9I7. The people were not impressed.

The I942 move was blamed on the war. The Federal Government decided an hour's more sunlight throughout the land would save electricity and help boost production.

From the Federal Health Department came swags of propaganda:

"It is a valuable, healthful innovation, specially beneficial to young children, hospital patients, industrial workers on early morning shifts, and rural workers."

Of course plenty of people didn't agree. The daylight savings debate had raged about the world for more than 30 years.

The then Premier, Sir Thomas Playford, thought the whole thing a disruptive waste of time.

"The saving in electric power is negligible when compared with the inconvenience suffered." he said.

"If English experience is any guide, the people who will feel the change most are those who are already early risers - milkmen, bakers, farmers, market gardeners, office cleaners, and tramway and railway men working early morning shifts," The News reported on the eve of the wartime change.

Daylight saving continued until the end of summer, when clocks were put back an hour. The system was introduced again during the following summer.

What did South Australians think about it?

It listed a few comments:

Suburban mother: Children don't go to sleep while it's still light outside. They just want to go on playing.

Union Secretary: I can't say I have had any general complaint about it. Most of the men seem to have accepted it. Personally, I like the idea.

Elderly Factory Worker: I have to get up at 5.30 every morning. It is still dark then, and so we don't save light. What we save at night is used up in the morning.

Amateur Gardener: It's been great to go home, have tea, and then have enough light to potter round in the garden.

Dairymen: It is most objectionable. We must rise in the dark and use lights to get our cows milked in time for the lorries. Then we must milk late in the evening to avoid the heat in the middle of the day. This gives us a much longer day's work.

The protesters won out. The State Premiers unanimously decided in August, I944, to leave the clocks alone.

Which would have disgusted William Willett. He was the father of daylight saving.

The idea came to him in a flash of morning sunlight early this century as his horse cantered over a common near Kent, in England.

He noticed that the blinds were drawn, the shutters firmly shut, on a large country house near by.

Inside, people were asleep. They should have been outside, enjoying the sun.

So with a singlemindedness possessed by the fanatical, he devoted the rest of his life to "conferring increased daylight on the workers of the world."

Willett died in I9I5, after years of campaigning and I9 editions of his pamphlet, "The Waste of Daylight."

Twelve months later the British Government finally saw his light. Daylight saving became law.

THE R.A.A.F. JUBILEE DISPLAY AT EDINBURGH, S.A. I7th April, I97I.

(By Nils T. Lied)
(OIC Met. Office, R.A.A.F. Edinburgh)

For weeks the preparations went on, and a slowly growing organized panic seemed to grip everyone - including the Met, Staff - Weather Officers, Nils Lied and Ab Deen.

Conferences and discussions with various "brass" from the Officer Commanding, down to the office cleaner's 4th assistant was the order of the day. The crux of the matter seemed to be an oft-repeated statement: "You'll be handling 7.2 units of every conceivable type of military aircraft, and some civilian ones thrown in, with weather requirements from the surface to 50,000 feet, and they'll be going in all directions at once, including blokes dropping out of aircraft by parachutes."

The O.C. demanded daily briefing on the weather three weeks ahead of the event. No sweat to us, - we just told him, "Fine, with a small element of doubt." He then announced that if it rained Ab and I had better head up the Birdsville Track, but fast, as he would be right behind us with a shot-gun. Early in the week, the weather started to look a bit dicky. Fronts, and all that. The O.C. bailed up Ab in the Met. Office and wanted an accurate forecast for Saturday I7th April. This was on Tuesday. Ab pointed out that it was not possible to be that accurate, i.e. amount and base of cloud, wind velocity, etc. that far ahead.

The O.C. then, after repeated attempts to get Ab to commit himself, burst forth in sheer frustration:-

"You're nothing but a piker!"

My unflappable companion just beamed at him.

Aircraft commenced to arrive Monday I2th April, mainly the "heavies" transporting British celebrants of all categories, and their gear. Then came Victor tankers, Lightning fighters, refuelled in the air enroute from United Kingdom via Singapore, Vulcan bombers, capable of flying direct from United Kingdom to Australia without refuelling, Macchis, Sabres, Phantoms, a huge Canadian Argus, Mirages, Winjeels, Canberras, Hercules, Britannias, Dakotas, Convairs, BAC III with VIP's and finally a flock of Iroquois Helicopters plus, of course, our own Orions from II Squadron.

On Thursday we had a rehearsal - on Friday full dress rehearsal and finally the big show on Saturday.

Met. requirements were for a mass briefing in the mornings about 9.30 a.m. of some 200 crew members. To facilitate this we had the standard map of Australia, which is normally used for T.V. and newspaper presentation, photographed, scaled down, and made into transparencies, IO" by 8", to be thrown on to a large picture screen. We presented a complete analysis at the surface, 3000 ft., IO,000 ft., I8,500 ft., 24,000 ft., 30,000 ft., - the "uppers" as a streamline-isotach anal. The briefings had of necessity to be in great detail, e.g. the parachutists wanted detailed winds at I,000 ft. intervals from surface to I2,000 ft.

The rehearsals went like clock-work and the atmosphere in the Officers' Mess every night was simply electric.

Saturday morning dawned somewhat threatening. Both Ab and I attended from the wee hours. The question was - How accurately could we time the passage of a trough, how much would a combination of diurnal improvement and a wind-shift behind the trough affect the display and would the following front tarry long enough to keep everyone dry? We plugged for the improvement, which we got, and the display was successfully conducted before more than 100,000 people, including H.E. the Governor of South Australia. In fact, the trough passed through at 11.00a.m. and the display got under way at 12.30 on schedule. The weather remained kind throughout the afternoon, and the subsequent front sailed majestically through the premises at 5.30 p.m. enabling us to look at it through the windows of the mess after completion of the show, clutching gratefully the first heart-starter of the evening.

Our busy period extended well into the following week, Sunday 18th and Monday 19th April, being our busiest days, and somewhat trying, as by then we had worked some quite incredibly long hours and were beginning to wonder if we had perhaps made a mistake in plugging for meteorology as a career. In other words, we were getting tired.

Requests for forecasts kept pouring in from all sources. My greatest moment was on Monday, when three crews crowded into the small Met. Office, and the leader of the push announced in a very clipped, British accent:

> "I say, old boy, could we possibly have a forecast to Singapore straight away? Up to 45,000 feet will do actually."

As I looked at him in consternation the phone rang, and a female voice asked:

"Listen, Luv, is it safe ter 'ang out me washing this arvo?"

It was then, but only then, that Lied said an extremely rude word in Norwegian and jumped on his good conduct medal.

However, everyone got what they looked for, and when it was all over the O.C. commended us for our services.

As always, a few funny incidents remain in memory. Like when the enormous Vulcan bomber put on climb-power over the VIP stand and blew a couple of very funny hats clean off the VIP's, the hats being expertly retrieved by highmarking R.A.A.F. boys. Then Ab came into the Met. Office and revealed the O.C. had promoted him to a new job - that of conducting distressed VIP ladies to the Officer's toilet, converted to "Ladies Only" for the occasion.

And when the Iroquois Helicopter in order to show its lifting power, slowly cruised past with a brightly painted FJ Holden suspended below it by a steel cable, and a crisp voice boomed over the loud-speaker:

"I say, that's a car you've got there! Drop it at once!"

The pilot must have had a keen sense of humour: He dropped it all right; from 200 feet. The result was spectacular!

Throughout, the co-operation and thoughtfulness extended to us by the R.A.A.F. was wonderful, as always.

We do feel, however, that every 50 years for this sort of thing to be staged is a very reasonable time limit.

HURRICANE NAMES
News Release from United States Department of Commerce, May, I97I.

Arlene: Beth: Chloe: Doria: Edith: One or more of these names make history this year. For they are lead-off selections among twentyone names chosen for the I97I crop of hurricanes in the Atlantic, the Caribbean and the Gulf of Mexico.

With the hurricane season beginning June Ist, the National Weather Service - a component of the Commerce Department's National Oceanic and Atmospheric Administration - today announced not only the name list for I97I, but also the names for the nine succeeding years until I98I.

A similar, four-year schedule of names has been selected for hurricanes and typhoons in the Pacific.

The custom of using women's names for hurricanes is an old one, dating back to I953 in the North Atlantic and even longer in the Pacific. Although the practice has been criticized recently by crusaders for women's rights, some of whom consider it derogatory, forecasters say that on the whole the public finds it a quick and effective way to focus attention on approaching storms.

"We intend no slur on women", says Weather Service Director George P. Cressman. "In fact quite the opposite. Hurricanes are among the most awesome forces in nature. No other storms equal them in combined strength, length of life, and power. Forecasters regard them with great respect."

Dr. Robert H. Simpson, Director of the National Hurricane Centre in Miami, Fla., reports:

"Never a year goes by but what I get literally hundreds of letters on our system of designating hurricanes. Most of them are from women, usually asking for a hurricane to be named after them. The last poll we took turned out 20 to I in favour of the practice".

American feminization of typhoons and hurricanes began during World War II, when forecasters were plotting the movement of great storms across vast theatres of war. Names such as Annie, Belinda, and Cora were much easier to remember than mere numbers or geographical co-ordinates. A storm with a girl's name had personality; you remembered it - and stayed alert. George R. Stewart's novel "Storm", characterizing "Maria" as a lady of fierce and majestic temperament - someone to be reckoned with - also did much to imprint the practice on the public imagination.

Since then, great storms such as Hazel, Carol, Betsy, Carla, and Camille have become a part of the American heritage. Their names are history, and carry a fundamental message to mankind: "Ignore us at your peril."

Dr. Simpson explained that the selection of names in the ten year list was made without reference to any particular individual. Names beginning with Q, U, X, Y and Z are not included because there are few of them and they frequently are hard to pronounce or write.

The names chosen for use in June through November of I97I are:

ARLENE	HEIDI	ORCHID
BETH	IRENE	PORTIA
CHLOE	JANICE	RACHEL
DORIA	KRISTY	SANDRA
EDITH	LAURA	TERESE
FERN	MARGO	VERNA
GINGER	NONA	WALLIS

The full list of names for the ten years I97I through I980 are given in a separate publication, issued this spring by the National Oceanic and Atmospheric Administration.

HURRICANE FACTS _ I97I

Hurricanes are tropical cyclones in which winds reach speeds of seventyfour miles per hour or more, and blow in a large spiral around a relatively calm centre - the eye of the hurricane. Every year, these violent storms bring destruction to coastlines and islands in their erratic path.

In these giant whirlwinds air moves in a large, tightening spiral around a centre of extreme low pressure, reaching maximum velocity in a circular band extending outward twenty or thirty miles from the rim of the eye. This circulation is counter-clockwise in the Northern Hemisphere, and clockwise in the Southern Hemisphere. Near the eye, hurricane winds may gust to more than two hundred miles per hour, and the entire storm dominates the ocean surface and lower atmosphere over tens of thousands of square miles.

The hurricanes that strike the eastern United States are born in the tropical and subtropical North Atlantic Ocean, the Caribbean Sea and the Gulf of Mexico. Most occur in August, September and October, but the six-month period from June Ist to November 30th is considered the Atlantic hurricane season.

Hurricanes also form along the west coast of Mexico and Central America, but their effects are seldom felt as far north as California. These threaten shipping and aviation, however, and are watched as carefully as their Atlantic cousins.

On average, six Atlantic hurricanes occur per year. However, there are significant deviations from this average. In I9I6 and I950, eleven hurricanes were observed, and no hurricanes were observed in I907 and I9I4.

During the I970 Atlantic hurricane season, seven tropical cyclones occurred, of which three reached hurricane intensity - Alma, Celia and Ella. The worst storm of I970, Celia, struck the Texas gulf coast, causing twentyfour deaths and property and crop damage estimated at 453.8 million dollars.

Since the beginning of this century, the hurricane death toll has declined markedly, as observation, prediction, and preparedness have improved. In the decade I900 through I909, more than 8,000 people were killed by hurricanes in the United States. Since I940, hurricane-caused deaths exceeded 500 in only one five-year period - I955 through I959,

But the decreasing loss of life is mirrored by the sharply rising property damage during the same period. Adjusting damage totals to the 1957-59 base of the Commerce Department's composite construction cost index, hurricanes caused less than $400 million in damage during the five-year period 1925-29, while deaths exceeded 2000. For the five-year period 1960-64, hurricane damages were nearly $1.2 billion, while the figure for 1965-69 rose to more than $2.4 billion. The dollar cost can be expected to continue climbing as greater numbers of expensive buildings are constructed in vulnerable coastal areas.

Hurricane winds do much damage, but drowning is the greatest cause of hurricane deaths. As the storm approaches and moves across the coastline, it brings huge waves, raising tides some fifteen feet or more above normal. The rise may come rapidly, and produce flash floods in coastal lowlands, or may come in the form of giant waves - which are mistakenly called "tidal waves". Waves and currents erode beaches and barrier islands, undermine waterfront structures, and wash out highway and railway beds. The torrential rains produce sudden flooding; as the storm moves inland and its winds diminish, floods constitute the hurricane's greatest threat.

The Work of Timely Warning

During the summer and autumn, the National Oceanic and Atmospheric Administration's Atlantic Hurricane Warning Service, headquartered at the National Hurricane Centre in Miami, and National Weather Service Hurricane Warning Offices at San Juan, New Orleans, Washington and Boston, maintain a constant watch for tropical disturbances which could develop into destructive storms. A similar effort, headquartered at National Weather Service Offices in San Francisco and Honolulu, counters the threat of Pacific hurricanes and typhoons.

Weather summaries from the National Meteorological Centre in Maryland, cloud photographs from orbiting spacecraft, ship and aircraft reports, measurements from a network of weather stations monitor the disturbance. When it appears that a storm is developing, Air Force or Navy reconnaissance aircraft or one of the aircraft of NOAA's Research Flight Facility is sent to the area to make a thorough investigation. Temperature, pressure and wind readings are taken, cloud structure is observed, and the extent, movement and position of the storm are noted.

As the storm approaches the Atlantic Mainland, the National Weather Service's radar fence picks up and tracks its movement. This buffer is a line of overlapping weather radars from Texas to New England, each station having a range of about 200 miles. Because hurricanes are also creatures of the sea, a watch is kept on tidal heights in the path of the storm.

Hurricane Watch

If the hurricane threatens coastal and inland regions, a hurricane watch is added to the advisory, covering a specified area and duration. A hurricane watch means that hurricane conditions are a real possibility; it does not mean they are imminent. When a hurricane watch is issued, everyone in the area covered by the watch should listen for further advisories and be prepared to act quickly if hurricane warnings are issued.

Hurricane Warning

When hurricane conditions are expected within 24 hours, a hurricane warning is added to the advisory. Hurricane warnings identify coastal areas where winds of at least 74 miles per hour are expected to occur. A warning may also describe coastal areas where dangerously high water or exceptionally high waves are forecast, even though winds may be less than hurricane force.

When the hurricane warning is issued, all precautions should be taken immediately. Hurricane warnings are seldom issued more than 24 hours in advance. If the hurricane's path is unusual or erratic, the warnings may be issued only a few hours before the beginning of hurricane conditions.

SUMMARY OF TALK GIVEN TO AUSTRALIAN MET. ASSOCIATION

SUBJECT: Antarctica and Antarctic Meteorology

by
N. T. Lied
Officer in Charge,
EDINBURGH S.A.

The ancient Greeks deduced that there was a great continent to the South, if for no other reason than that it had to act as a counter-balance to the then known world - it became known later as Terra Australis.

Old Maori legends, dating back to A.D. 750 suggest that the Polynesians were the first people to venture South on their voyages of discovery. Their descriptions of the pack-ice, the islands they saw and the penguins, seals and oceanic birds, not to mention whales, were so accurate that little doubt is left about their southern journeys.

Antarctica, as we know it today was discovered, partly by merchant-cum-sealers-cum explorers, partly by organized Government-sponsored expeditions, such as those led by Captain Cook and Sir James Clark Ross. The first men to set foot on the Continent were led by a Norwegian, Capt. Bull in I895 and another Norwegian C. Borchrevink subsequently wintered for the first time, near Sir Douglas Mawson's camp at Cape Adare and Commonwealth Bay, Adelie Land, in I899. An Australian, the Physicist Bernacchi, from Tasmania, was a member of that expedition.

The great unknown Southern Continent rapidly captured the minds and imagination of men - some for the pursuit of science and exploration, others for mercenary gain and through the ensuing years a great many expeditions ventured south; in relatively recent times led by such men as Scott, Shackleton, Amundsen and Mawson, to mention a few.

The South Pole, the ultimate goal was reached by Amundsen and four companions driving dogs on December I4th I9II and the tragedy of Scott and his men followed one or two months later.

For some years exploration slowed down, until the advent of the International Geophysical Year, when twelve nations moved in and set up highly sophisticated scientific bases at widely scattered points around the Antarctic coast. Australia had already formed A.N.A.R.E., i.e. Australian National Antarctic Research Expeditions with bases at Heard Island and Macquarie Island. To be able to finance the setting up of a base on the Antarctic Continent, Heard Island unfortunately had to be closed down after five-six years operation and our main base at Mawson was the result. We have since expanded and in I957 Davis was established. Later Australia took over the United States Base at Wilkes, which was rebuilt completely on a new site two years ago and named Casey. These three bases on the Continent, plus the old Macquarie Island Base now constitute Australia's commitments in Antarctica.

Antarctica, known as the Seventh Continent, consists of approximately five and a half million square miles of ice and rock. Australia, Europe and the United States of America could comfortably fit inside its boundaries. The ice cap covering most of the Continent has been calculated to be seven and a half million cubic miles of ice and, should this suddenly melt, the levels of the world's oceans would rise some two

hundred and fifty feet. Apart from its enormous size it is the highest, the coldest and the windiest continent of Earth. Air heated in the tropics rushes Poleward in the upper atmosphere and descends over the polar ice-cap, where intense cooling takes place. Deflected by the Earth's rotation the winds move by gravitation towards the coast from a southeasterly direction, often developing hurricane force. The prevailing winds and the Earth's rotation cause the west-setting currents that encircle the Continent. Near approximately 65 degrees S, however, winds and currents begin to turn eastward, merging with the great belt of prevailing westerlies and the "West Wind Drift". The howling, downslope gales are the bugbears of ice explorers. They range in velocity from a "gentle" 50 knot breeze up to two hundred knots in places like Commonwealth Bay and, as a consequence, govern the explorers' everyday lives, their ability to move about, or otherwise, and their tempers. Another word for these winds is the "Antarctic Blizzard", a phenomenon which must be experienced to be believed. Invariably the great winds are accompanied by snow, which arrives with the incredible violence of a horizontal avalanche.

However, these winds are not always constant. On many occasions I have stood out on the frozen sea, or up on the polar plateau, holding an unflickering match flame in front of my face. Apart from the violence of the blizzards, we also have calm, sunlit days of unsurpassed beauty. It is not all ice, however. Tops of great mountains burst up through the polar ice cap, stark, bare and supporting no life, except crude lichen and a few nesting birds. In summer the islands off shore and the ice-free rocks along the coast teem with life.

Millions of penguins nest there, as well as innumerable oceanic birds. Seals haul up and give birth to their young, and the noise of their young and the noise of intense life and procreation is deafening. The oceans around the Continent support enormous quantities of plankton, which may one day become the source of food for a starving world.

Our bases are by now quite sophisticated. Even nuclear power plants are in operation at United States and U.S.S.R. Bases. We have the best of shelter, the best of food and clothing and a variety of transport from dogs to tractors and helicopters.

Apart from Meteorology, a great number of disciplines within the compass of geo-physical sciences are pursued in Antarctica - Biology, Physiology, Botany (whether you believe it or not!) Glaciology, Oceanography, Seismology, the Earth's Magnetism, Research into Meteorites, Aurora, the Ionosphere, Cosmic Rays, to mention some of them, as well as such mundane things as testing of fuels, building materials, prepared foods, types of insulation, clothing etc. - and last, but not least, the exploration and accurate mapping of this vast area.

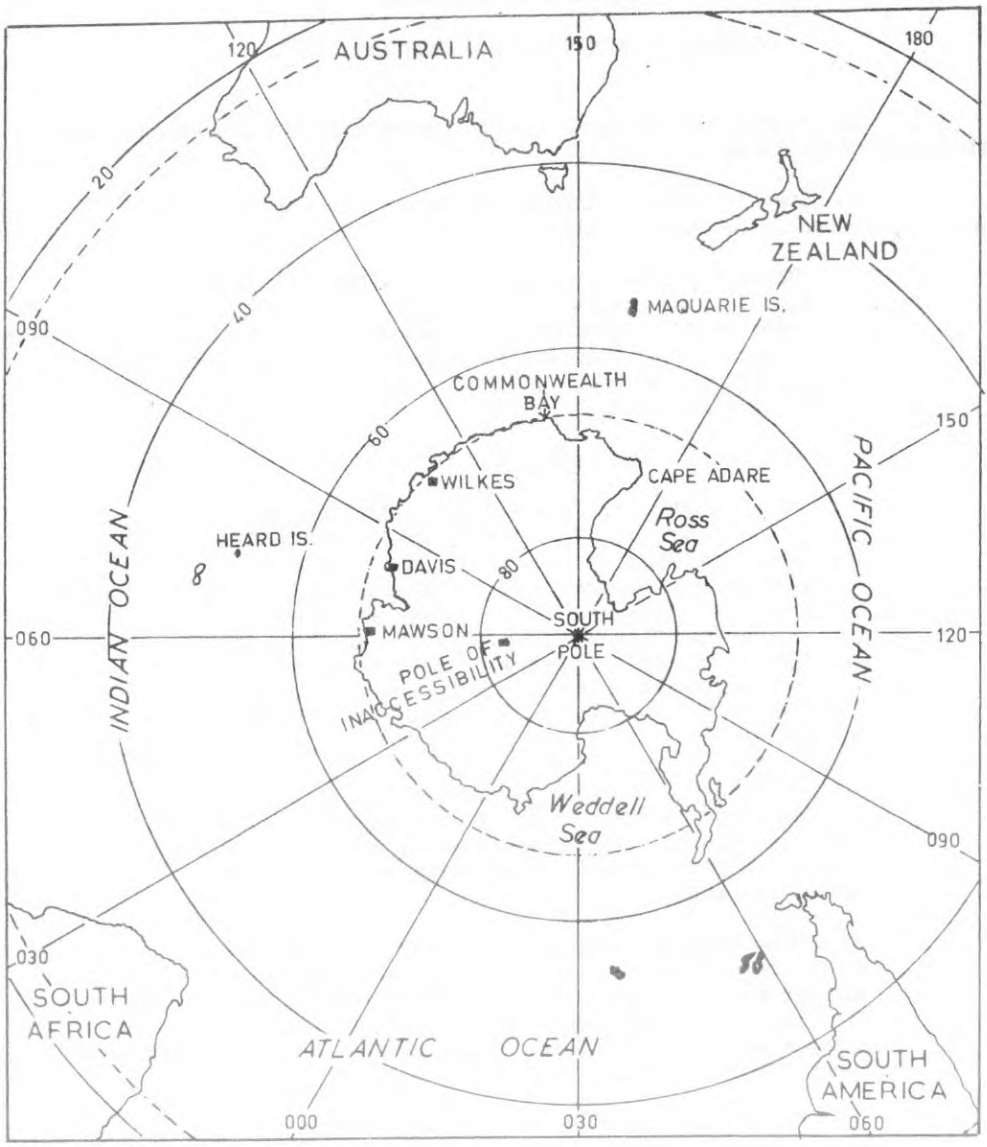
Everything which is undertaken is just a little more difficult in the great Southland due to terrain, temperature and wind. The warmest? - from memory - approximately 47 degrees F. one Christmas day at Mawson - the coldest minus 123.6 degrees F., i.e. 156 degrees F below freezing, at the Russian base near the Pole of Inaccessibility in the high interior, where the Polar Plateau is some 12,000 feet above sea level.

The thickest ice measured? - 17,600 feet, of which over 7,000 feet was below sea level and the biggest ice berg we discovered was some ninety miles long, fortyfive miles wide and roughly rectangular.

On one of my voyages south we passed a fair-sized tabular iceberg and some enterprising young physicist decided to calculate its cubic volume and, subsequently, how much whisky would be needed to have one cubic inch per standard nip of that excellent brew. After a long struggle with his slide rule he triumphantly announced - "I6,000 tankers of 20,000 tons each full of Mature Scotch!"

One of the greatest results of the I.G.Y. is the Antarctic Treaty. All nations with claims to Antarctic Territory signed the Treaty on December Ist, I959, declaring the area south of 60 degrees S latitude an international reserve for scientific research. Thus, scientific groups can move freely on the Southern Continent disregarding "boundaries". Furthermore, no military establishments, or testing of weapons of war can ever be made in the region.

Apart from the results of research, the publishing of one's papers and the satisfaction of working in close harmony with groups of fine men, the most rewarding experience - at least for me - was to stand with my dog-teams, or tractor at some place, be it inland, or along the coast, and say to myself: "No man has ever stood here before."


AUSTRALIA
NEW ZEALAND
MAQUARIE IS.
COMMONWEALTH BAY
WILKES
CAPE ADARE
Ross Sea
HEARD IS.
DAVIS
MAWSON
SOUTH POLE
POLE OF INACCESSIBILITY
Weddell Sea
INDIAN OCEAN
PACIFIC OCEAN
ATLANTIC OCEAN
SOUTH AFRICA
SOUTH AMERICA
120
150
180
090
060
030
000
20
40
60
80

APPRECIATIVE REFERENCES

BUREAU OF METEOROLOGY - FEBRUARY, 1971

Two recent editorials on cyclone matters in the Queensland press speak for themselves.

The State's largest-circulation paper, the morning Courier Mail, commented on February 20 under a heading of "Cyclone Alerts"....

> "Next to travelling salesmen, weather forecasters are the world's most popular butt of jokes, jibes, criticism and assorted fault-finding. But this week, the Weather Bureau showed just how far the science of weather forecasting and the business of public relations (in its best sense) have advanced.
>
> "The public was kept fully informed of possible danger.
>
> "Possible" is the crucial word. Cyclones will not run to a set pattern. They behave in random fashion. This week, cyclones did not behave quite as expected in Bureau warnings. Caloundra, for example, was alerted, but a shift of track saved it. Damage at Redcliffe (not so far away) showed how lucky the Sunshine Coast was. People on the Northern and Central coasts also have reason to thank the Bureau for the numerous warnings as "Cyclone Alley" became a meteorological speedway during the week.
>
> "Warnings do nothing to abate a cyclone's fury, but they do alert people to take shelter after securing property, loose items in the grounds, and their boats. Evacuation procedures in flood-prone locations also can be prepared.
>
> "The Weather Bureau has a vastly improved cyclone detection and tracking service. Not many years ago it was far more a guessing game than now. Weather satellites, more radar and offshore detection stations (plus a lot more science and experience) are coupled with a better integrated communications service.
>
> "Mere capsule-style listings of Queensland's cyclonic ravages run into pages. People should never become complacent and think the Bureau is crying "wolf". Those who make that mistake could rue it next time."

The Cairns Post editorial on February 24 was under the heading "Warning Plan Effective" :-

> "Timely warning of approaching danger has proved its value in many a human crisis. Proof of the timeliness and effectiveness of the cyclone warning system developed in Queensland was given in recent weeks. Repeated official warnings permitted residents in a vast expanse of Queensland to take precautions to minimise damage from the winds which accompanied the series of cyclonic depressions.

"Without belittling in any way the magnificently sustained efforts of the Weather Bureau officials who distributed a continuous stream of up-to-date warnings with the aid of communication media, scientific progress enhanced their accuracy.

"An innovation which made the task of tracking disturbances less a matter of educated guess, as was sometimes the case in the past, was the information beamed from the two weather satellites. Their pictures, backed by surface reports, showed the movement of the centres and permitted fairly accurate prediction of their courses. There had been criticism of the campaign conducted by the Bureau of Meteorology to emphasise the danger and to indicate possible precautions. However, under the acid test of a real emergency, the scheme showed its value.

"It is doubtful if anyone now would urge discontinuance. All will be hopeful, however, that the Bureau's efficiency will not be subjected again to so many tests in such a brief time as has been the case this year. One point brought out through Dora's rampage in the Redcliffe area and Gertie's onslaught which severely damaged Far Northern banana crops is that buildings in most parts of Queensland need more built-in strengthening. In the North this has been customary for years and property damage reduced accordingly. An effectively braced building is much less likely to suffer and the cost of protection could be regarded as a necessary insurance premium.

"The cyclone season could extend to March and into April but it is now clear that we can depend on getting timely warning through an alert and adequately informed Bureau."

Using the Weather Forecasts to Best Advantage in Fire Fighting
The Willaston (S.A.) Fire on I7th January, I969

The following report was forwarded by Mr. E.H.V. Riggs, District Officer, Munno Para Emergency Fire Services, to illustrate how losses can be minimised, even in the midst of dangerous conditions, by utilizing the forecasts to make best use of all available men and equipment.

"As Supervisor, I received the fire call from Gawler Fire Brigade at I250 hours. I called One Tree Hill, Smithfield and Evanston units, and then left for the fire.

The temperature was I02^{o} with a northwest wind of 45 knots and prolonged gusts up to 55 knots. The dust was severe with a visibility of no more than 20 yards and sometimes nil. No smoke could be seen.

I had great difficulty in locating the fire and it was first seen when I was in amongst burning haystacks. I had actually passed through the fire without seeing it.

I was in radio contact with the other three Munno Para units who were nearing the fire. We met on the Gawler By-Pass and attacked the fire along the Gawler/Roseworthy College Road.

There were a number of small farms along this road, mostly on the eastern side, with sheds, haystacks etc. These were all saved. Muddla Wirra E.F.S. and other units were on the north end and it seemed that the fire was comming under control at this stage, but one could only see a few yards.

A sand hill to the west was blowing badly and at one stage the drifting sand was actually smothering the fire.

The fire crossed the road at the northern end and continued towards the Gawler By-Pass, which is a two lane road and normally a very effective break.

I arranged for Police to close this road to all traffic and assembled fire units and a line of men with knapsacks along the eastern side of the road across the head of the fire.

There was a terrific wind gust as the fire arrived; grit from the side of the road was rattling against the vehicles. We felt the fire go across, but I don't think anyone saw it, except that the grass, which was only light here, was burning around us and a large patch of native pines in the cemetery was blazing.

The wind then dropped quite a bit and we waited on the other side of the cemetery where a chain road was cleared from fence to fence.

Undergrowth was wetted as far in as could be reached. The fire was being attacked from the north and south sides and was stopped on the road to the east of the cemetery.

Several gum trees were burning on the road along the northern edge of the fire, and a stack of baled hay about 200 yards in from the edge was alight. Balls of this were rolling across the burnt ground.

We had been in touch with the Met. Bureau through the base telephone and were aware that a change of wind was coming at about 1500 hours. Most trucks were able to refill with water and several burning trees were pulled over or cut down along the northern edge.

We had frequent reports from Met. and our count down was as perfect as it could be. The wind had dropped and we could see the wall of dust coming from the southwest.

One Tree Hill and Smithfield units, which each have Magirus pumps were placed in the two most dangerous spots, with two other follow-up units each. There were other units in other strategic places.

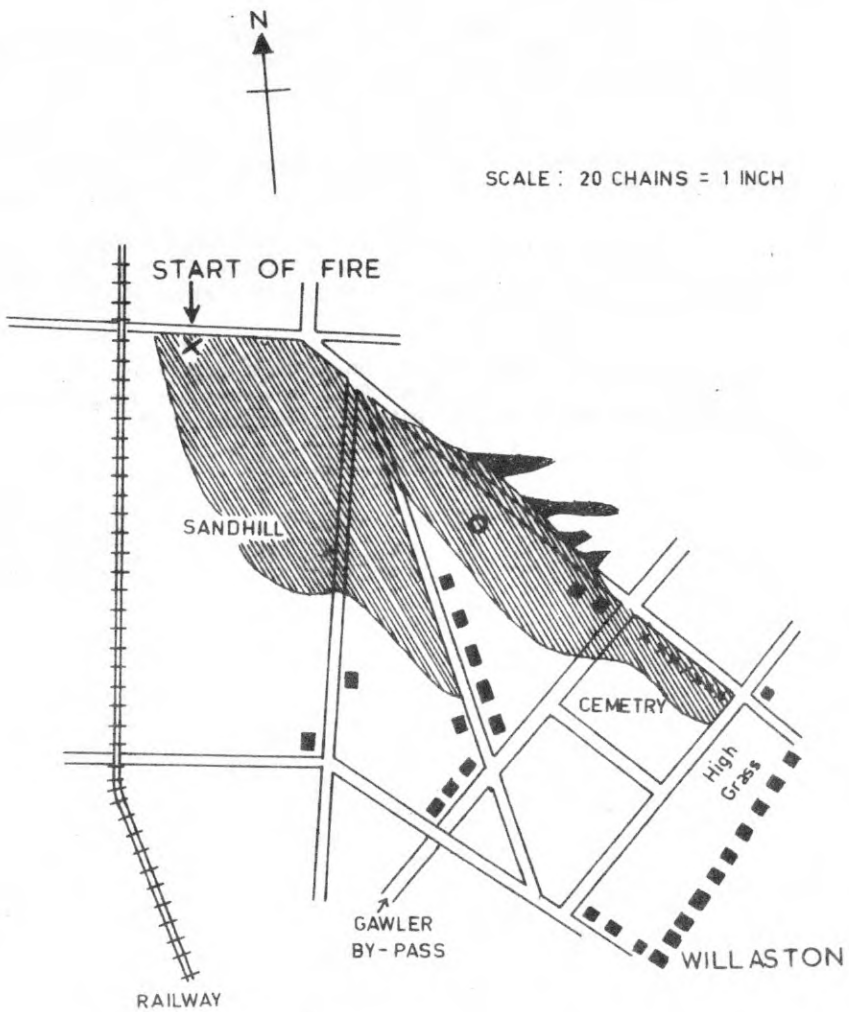
The change of wind from the southwest arrived within a few minutes of the time forecast by Met. with a force of 55 knots. Outbreaks occurred in four places, but, owing to the great force of the wind, were fairly narrow leads.

The units were right on to them from the start, and as a Magirus pump with a 3/4 inch nozzle at full pressure can really throw some water, all the outbreaks were out within a few minutes."

E.H.V. Riggs,
District Officer,
Munno Para E.F.S.

WILLASTON FIRE

17 - 1 - 69



THE BUSH FIRE

By Laurie Wells

Quick! The warning cry is speeding
to the country further out.
A fire with a two-mile front!
And tearing to the south!

Then there's panic and confusion
and the women are afraid
as they watch their menfolk gather
for the bush fire brigade.

And they're racing to the fire
which is leaping wide and high.
If they cannot halt the demon
they may bid the town goodbye.

Now the men are in among her,
cutting, beating everywhere,
to build a break to stop her
in the smoke infested air.

The hungry tongues of fire jump
to log and tinder grass
and every fighter's thinking
we must not let her pass.

And the homesteads in the mallee
are deserted up ahead.
With the cloak of night descending,
their occupants had fled.

For the demon's gaining slowly
fought alike by young and old
and everyone is praying
that the puny break will hold.

But their hopes are vainly shattered
as the wind takes on a change
to urge the fiery monster
across the grassy plains.

And she's roaring unobstructed
now assisted by a breeze,
and she leaps through fence and paddock
with all consuming glee.

The air is like a furnace.
Dirty sweat on every brow,
and the desperate men must leave her.
No chance to hold her now.

Suddenly a peal of thunder,
like the close approach of drums,
and the heavens fill with lightning
then down a shower comes.

The rain descends in torrents
like a saviour in the night
and it helps to ease the tension
on the faces strained with fright.

The news is spread next morning
from the men out on patrol
that the fire's eased its fury
and under safe control.

The author of this poem is an

Aboriginal. He lives at

Gwynneville, N.S.W.

Reproduction is by permission of

The Editor, New South Wales

Bushfire Bulletin.

SOME METEOROLOGICAL ASPECTS OF AIR POLLUTION

By
J. HOGAN

Regional Director, Bureau of Meteorology, South Australia
An Address to the Association - February, I97I

"Meteors" are defined in Webster's dictionary as "things in the Air". It seems most appropriate, therefore, that a Meteor-ologist should be requested to give his views on some of the less welcome "things in the Air" called pollutants.

In any investigation into air pollution the approach is dependent on the scale of the analysis which it is proposed to undertake. The researcher's interest could be in either:-

(a) Widespread low concentrations of pollutants which may affect our climate, or

(b) Localised high concentrations which may be detrimental to the health of humans, plants and animals.

In reference to (a), overseas Researchers have discovered a considerable fluctuation in the low density concentrations over wide areas with annual averages showing an increasing trend in some places and a decreasing trend in others. They have examined variations in the Carbon Dioxide content of the atmosphere by taking measurements at air intakes of jet aircraft en route between Scandinavia and California. There is evidence to suggest a steady increase in concentrations which by the year 2000 would approach 365 parts per million as compared with the present value of 320 parts per million. A world wide increase of Carbon Dioxide of a similar degree could imply a gradual change in climate due to a change in radiation balance in the lower atmosphere. Similar effects might also be attributed to increases in other solid and gaseous pollutants.

In this talk it is intended to concentrate mainly on the meteorological conditions associated with (b), the localised high concentrations which are likely to have more immediate dangerous health effects.

Although the term "smog", which has been referred to many times by previous speakers, was originally coined to describe a combination of "fog and smoke", it is now used in a more general sense to describe all forms of air pollution whether associated with fog or not. However, it is reasonable to assume that the high moisture content of the atmosphere associated with fog could aggravate the effect of pollutants by converting some of the gases into active acids which cause corrosion and irritation.

During the disastrous smog in London in I952, 4,000 people are said to have died from the effects of concentrated pollutants, particularly Sulphur Dioxide, but other workers in this field claim that there have never been any known deaths which can be directly attributed to Sulphur Dioxide, although it is conceded that it can cause severe distress in those suffering from chronic respiratory diseases.

On the contrary there is some evidence to suggest that increased

concentrations of SO_2 may even be beneficial to some asthma sufferers who are allergic to house mites which live on discarded human skin scales. A significant reduction in the output of SO_2 in a locality where the prevailing winds had previously deposited it on the township is alleged to have been accompanied by a rise in the incidence of asthma. It has been suggested that this may have been due to a consequent increase in the mites whose existence may have previously been limited by the effect of the Sulphur content of the air. This, of course, remains to be proved.

As a result of the London disaster in 1952, a Committee, known as the Beaver Committee, was set up to investigate the "smog" problem in Britain and, in its report published in 1954, it was estimated that the losses due to air pollution in Britain amounted to $A500 million per annum. It is interesting to note that this included losses incurred due to additional expenditure on:-

Laundry

Painting and decorating

Cleaning

Corrosion

Damage to consumable goods, etc.,

and did not include losses in wages due to absenteeism nor reduction in primary production due to damage to crops.

It is doubtful if we have, as yet, a comparable problem in Australia, but action must be taken now to ensure that we never do have one. In looking at it from the Meteorologist's point of view there are two main considerations:-

(a) The source of pollutant, and

(b) The dispersal of the pollutant.

It is not the purpose of this address to elaborate on (a) except to say that, in any assessment of pollutant potential, we must differentiate between moving and stationary sources. The variation in intensity of the output from stationary sources is relatively easily measured and controlled, but the output from moving sources such as aeroplanes and motor vehicles will be variable in time, space and concentrations, and is much more difficult to measure and control.

It is claimed that burnt fuel from motor vehicles is the source of half the air pollutants in the United States. It is also claimed that the combustion of leaded gasoline is a major source of lead particulates in the atmosphere. The role of this pollutant in producing long term adverse effects in our bodies has yet to be explored.

It is not intended to elaborate further on the nature of the pollutants, but, in studying their dispersal, account must be taken of the fact that they can be solid or gaseous, toxic or non-toxic, and that there will be a considerable variation in the density causing temporal and spatial variation in sedimentation of the materials. Pollutants from natural sources such as salt particles from the sea, smoke from bush fires,

dust from dust storms and volcanoes, etc. must not be overlooked. In addition, we cannot afford to ignore the spores, pollens and fungi which are acknowledged causes of allergic and other respiratory diseases. Pesticides, viruses and radio active pollutants must also be taken into account.

It should be obvious by now that a study of atmospheric pollution covers a wide field, but this talk is concerned only with the meteorological aspects of (b), the uptake, transport and deposition of pollutants, which are controlled by two main weather elements:-

I. Prevailing wind strength and direction at, and slightly above, ground level, at the time of origin of the pollutant.

2. The thermal structure in the lower layers of the atmosphere.

The synoptic weather situation at the time governs the direction and strength of the wind near and slightly above the earth's surface. There are also certain synoptic situations which promise low level temperature inversions in which the normal lapse rate, or decrease of temperature with height, is reversed, resulting in what is known as a stable atmosphere. This is illustrated in diagram (I) showing temperature plotted against height above the surface, where temperature increases with height for a few hundred feet and provides one of the necessary ingredients for the typical "smog" situation. This usually results from a synoptic situation in which we have calm to light winds and clear skies overnight. Adelaide Airport was closed by fog with a visibility of only 300 yards on this morning. The more pronounced upper inversion at 5,000 feet was due to subsiding air being warmed by adiabatic processes.

That Adelaide lends itself to this type of development is shown by the illustration in diagram (2) which is based on actual reports from stations in the Metropolitan area. The temperature is 40°F near the surface and 57°F at 250 feet. The nearby ranges permit a katabatic flow of air into the western suburbs on calm clear nights resulting in well established inversions over the area between the City and the coast. Diagram (3) illustrates a much stronger inversion in the lower levels. This was associated with the smog over Adelaide on the IOth of February which was the subject of a photograph in the Advertiser Newspaper on the IIth February this year.

It would be reasonable to conclude that, if we had a ready supply of pollutants coinciding with winds which would cause their dispersal into this type of stable atmosphere, we could be faced with a serious problem if the pollutants were of a toxic or irritant nature. A large increase in vehicular traffic in a smog prone area could provide a ready source of carbon monoxide which would undoubtedly be detrimental to the health of the people in this area.

In studying atmospheric transport of pollutants we cannot afford to ignore air-borne diseases which might affect human, animal and plant life. The air-borne transfer of the foot and mouth disease virus has been the subject of considerable investigation overseas, particularly in England, and there is fairly conclusive evidence that some outbreaks are due to a virus which has been air-borne from the Continent. Consideration is now being given to setting up a danger warning system, based mainly on meteorological parameters, for predicting outbreaks of this disease.

Our investigation into the relationship between asthma, weather and spora has necessitated the installation of pollen and spore traps at several locations in the Metropolitan area. These traps operate on the principle of sampling a fixed volume of air per unit time which is drawn over a slide covered with vaseline on which pollen, spores and other pollutants are collected. A complete traverse of the slide is made in twenty-four hours. The photo shows that the concentration of pullutants varies considerably from hour to hour and from day to day. There are also occasions when a high concentration occurs for only a short period of two to three hours, and it is during this short period that pollutants could be detrimental to health if toxic or irritant materials formed a major part of the pollutant. It is imperative, therefore, that shorter time scale measurements of pollutants should be made, that the content of the pollutants be carefully analysed and that variations in concentrations should be correlated with meteorological conditions.

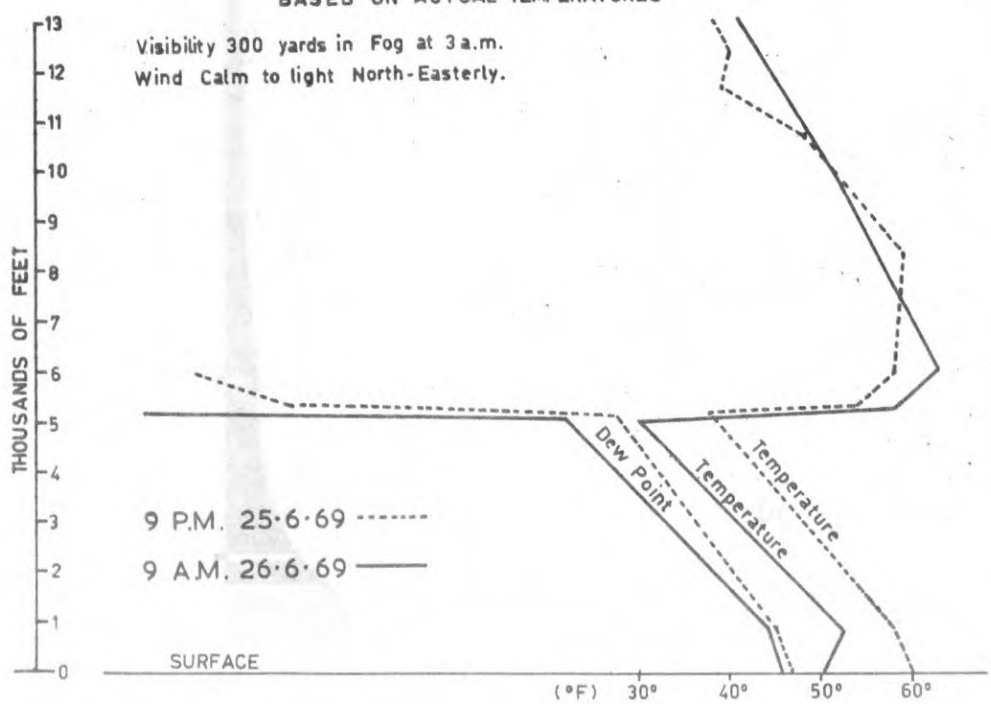
It is likely that, as a result of the recently published Senate Select Committee's recommendations on Pollution, the Bureau of Meteorology will have the responsibility of setting up a network of air pollution monitoring stations throughout Australia with the aim of eventually providing a predictive service for warning of potentially dangerous situations.

1. LOW LEVEL TEMPERATURE STRUCTURE FOR TYPICAL SMOG SITUATION

ADELAIDE AIRPORT

NIGHT OF 25th-26th JUNE 1969

BASED ON ACTUAL TEMPERATURES



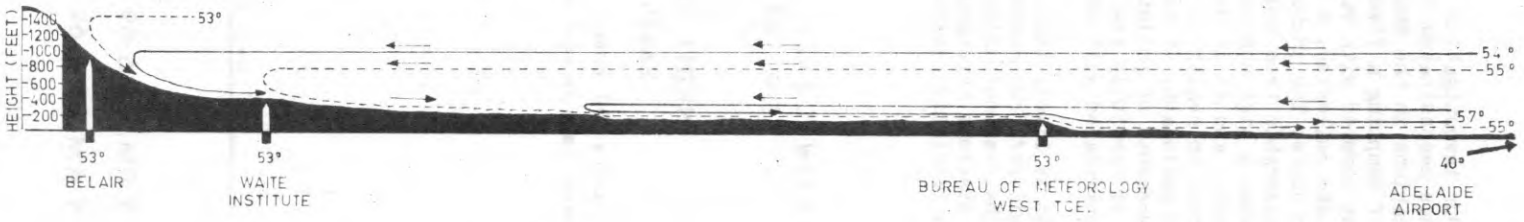
2.

ADELAIDE S.A.

IDEALIZED CROSS SECTION OF METROPOLITAN AREA ON A CALM WINTER MORNING

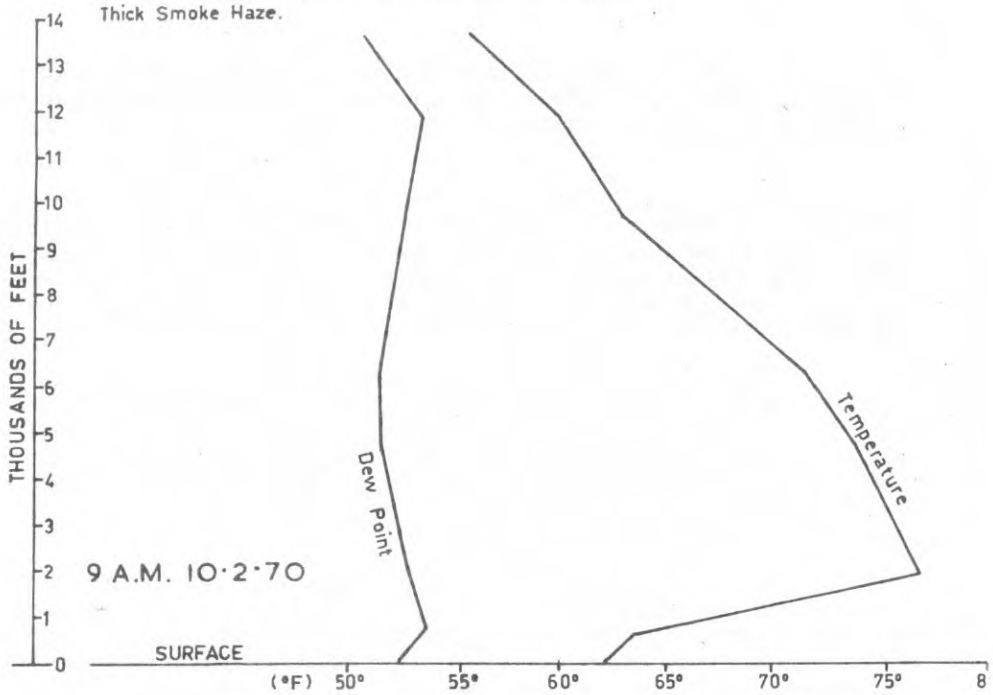
SHOWING

TEMPERATURE DISTRIBUTION AND DRIFT FLOW



3.

LOW LEVEL TEMPERATURE STRUCTURE
FOR TYPICAL SMOG SITUATION
ADELAIDE AIRPORT
MORNING OF 10th FEBRUARY 1970
BASED ON ACTUAL TEMPERATURES



THE USE OF GHOST BALLOONS TO OBTAIN UPPER ATMOSPHERE DATA AND A SUMMARY OF RECENT LAUNCHINGS CARRIED OUT AT DARWIN

The GHOST (Global Horizontal Sounding Technique) Programme is designed to gather information from a number of balloons, each carrying a radio transmitter and floating at various fixed levels in the upper troposphere.

In the past, study of the general atmospheric circulation in the southern hemisphere has always been hampered by lack of conventional meteorological data over the oceans. However, the development of numerical forecasting methods has made it imperative to obtain data such as temperature, humidity and wind over these areas and the use of free floating balloons as observing platforms is one way of doing this.

In an earlier project (Transosonde Project) 1957-1959, the U.S. Navy released 100 balloons over the Pacific Ocean and tracked them with direction finders. The heavy Transosonde balloon payload, however, was considered a hazard to aircraft and the project was discontinued. Since then, the development of strong, high modulus plastic films and microminiature electronics has enabled the production of reliable balloons, carrying non hazardous payloads, for use in the current GHOST soundings.

The southern hemisphere test programme was initiated in Christchurch, New Zealand in 1966 as a joint research undertaking of the New Zealand Meteorological Service and two United States groups, one of which, the National Centre for Atmospheric Research (NCAR) manages the programme. Christchurch has been the principle launching point for the Project, but launchings have been made at other places, including a recent series at Ascension Island and Darwin, in the tropics.

TYPE OF BALLOON

The GHOST balloon filled with helium gas is made of laminated mylar plastic and is spherical in shape when fully inflated. The balloons vary in thickness (25 to 63 microns) and diameter (6-22 feet) depending on the desired float level, which may be as low as 20,000 feet or over 90,000 feet.

At launch, the balloon is very limp but becomes fully inflated when it reaches the correct altitude, due to reduction in atmospheric pressure and expansion of the gas in the balloon and continues to float at a constant density level.

TRACKING THE BALLOON

Each balloon carries a simple solar powered transmitter capable of operation between sunrise and sunset. The energy of the sun starts the transmission of identifying morse code letters and the rate at which the code letter is transmitted depends on the altitude of the sun. Near sunrise, with a low level of solar radiation reaching the balloon package the speed is slow (up to 40 seconds), but at noon, with maximum solar radiation it is more rapid (down to 15 seconds).

The solar panels on the balloon package generate I3 volts of electrical energy allowing a transmitting capacity of 2 to 3 watts and giving a radio signal range of at least I,000 to I,500 miles and sometimes as much as 3,000 miles. This ensures that the balloon is always within radio range of one or more monitoring stations in the southern hemisphere. Receiving points have been set up at Christchurch, Pretoria, Beunos Aires, Lima, Honolulu, Manila, Werribee (Melbourne), Perth and on board USNS Eltanin.

POSITION OF BALLOON FOR WIND FINDING

The basic theory behind the location technique is that at any given moment in any particular day the sun is directly overhead at only one point on the earth. Moving away from this point, the elevation of the sun will decrease. As one sun angle reading will only establish the position of the balloon on a circle around the sun's zenith point, at least three readings within a short time of each other are required to establish a unique position for the balloon.

Knowing the sun angle and the position of the balloon at different times during the day, the longitude at its noon position can be calculated and a graph drawn up showing its trajectory during the day.

From the movement of the balloon over a period of time the mean wind speed at that level can be obtained and this information is then used in the construction of meteorological synoptic charts.

DURATION OF FLIGHT

The theoretical life of an unflawed, plastic balloon is determined by the rate of gas diffusion through the balloon walls and this in turn depends on the type and thickness of balloon material, balloon size, internal pressure and temperature. A balloon which loses 0.0I per cent of its gas per day and has a ten per cent higher pressure inside than outside, should fly for I,000 days. However, factors such as leakage from small pinholes, icing at levels below 40,000 feet and degradation of the plastic by ultraviolet radiation (particularly at high altitudes) help to considerably shorten the balloon life.

Balloons flying at 55,000 feet and higher are able to remain aloft for many months and some have remained operational for over 400 days, circling the southern hemisphere more than 25 times.

If it is desired that a balloon should only stay aloft for a short period a mechanism to destroy the balloon can be set to operate at some time, say two to three weeks after launch.

IMPROVED GHOST PACKAGES

The standard GHOST balloon package consists of a simple device for transmitting sun angle, but additional sensors, such as temperature and humidity elements, can be added and share the same transmitter.

A more complex package, known as digi-GHOST will give temperature, humidity and ozone measurements. It also incorporates an improved position finding technique involving the use of a magnetometer to record the vertical component of the earth's magnetic field. As the magnetic field for any point around the earth is known, a value of this field

together with the sun angle enables a unique position to be obtained. This also allows the approximate positioning of the balloon on occasions when cloud prevents obtaining proper readings of sun angle.

BALLOON-SATELLITE SYSTEMS

With the launching of the American Nimbus D Satellite GHOST packages capable of being interrogated by satellite are being tested. Each balloon has a receiver and decoder to recognize its address when called and its position is then established by making two range measurements from satellite to balloon.

One satellite can interrogate each balloon at twelve hour intervals and as the balloon transmitter will be on for only brief periods of time, thin film, non hazardous batteries, can be used for night operation.

The launching of GHOST balloons at Darwin was conducted under the U.S./Australian Agreement for Scientific and Technical Co-operation with Australia acting as Lead Agency. Dr. Henri van de Boogaard of the National Center for Atmospheric Research was Technical Adviser and Leader of the team of American scientists.

Facilities, such as hangar and workshop space were kindly provided by RAAF Darwin and Australian Bureau of Meteorology personnel assisted at the launchings.

The purpose of the Darwin launchings was to investigate tropical air currents, particularly upper level easterlies and comprised the launching of ten balloons between early February and early March 1971, to the following levels:-

6 balloons at 47,000 feet (150 mb)
2 balloons at 55,000 feet (100 mb)
2 balloons at 59,000 feet (80 mb)

NOTE: Balloon diameter averaging 15 feet.

In general, launch conditions were good with calm conditions and good weather, enabling balloons to be launched by hand. However, the Darwin experiment has highlighted the problem of finding the position of the balloon in clouds as the reduced sun intensity slows the morse code transmission, resulting in an incorrect sun angle.

Four balloons burst soon after launching due to either icing in thunderstorm cloud, or the fact that low temperatures at float altitude forced the balloon higher than anticipated.

Most of the remaining successfully launched balloons floated westwards to near Cocos Island, before being caught in westerlies and moving southeastward over Australia toward middle latitudes.

Three balloons were launched in a space of twenty minutes to determine the extent of upper air divergence, but of these only one remained aloft for more than a few days.

Experience gained from this experiment will be of great assistance for future launchings.

McALISTER PRINT 4955/71